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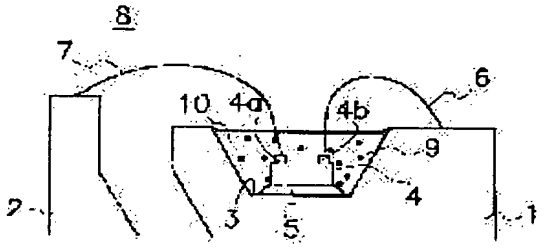
(71)Applicant : SANKEN ELECTRIC CO LTD
(72)Inventor : SANO TAKESHI

(54) SEMICONDUCTOR LIGHT EMITTING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce unevenness in chromaticity by improving an emission spectrum of a semiconductor light emitting device.
SOLUTION: A fluorescent layer (10) provided on a circumference of a semiconductor light emitting element (4) contains one or more types of a phosphor (9) excited by near ultraviolet light to be emitted from the element (4) to emit light having a wavelength different from that of the light emitted from the element (4) and a transparent polymetalloxan gel solidified from a liquid-like ceramic coating agent containing a metalloxan bond as a main body. Since the emission spectrum of the near ultraviolet light generated from the element (4) has a very sharp peak and high sharpness, the near ultraviolet light of the element (4) is wavelength-converted by the layer (10). Thus, a bright color having a sharp emission spectrum can be expressed as compared with a conventional semiconductor light emitting device.



* NOTICES *.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] wiring of a pair -- a conductor and this wiring of a pair -- with the cup section formed in one edge of a conductor said cup circles are pasted -- having -- and said wiring -- with the semi-conductor light emitting device which is electrically connected to a conductor and generates near-ultraviolet light In semi-conductor luminescence equipment equipped with the transparent closure object which covers one edge and fluorescence layer of a conductor the fluorescence layer prepared in the perimeter of said semi-conductor light emitting device, said semi-conductor light emitting device and a bonding wire, and wiring -- Said fluorescence layer is excited by the near-ultraviolet light irradiated from said semi-conductor light emitting device, and contains the fluorescent substance more than a kind which emits the light of the luminescence wavelength of said semi-conductor light emitting device, and different wavelength. Said fluorescent substance layer is semi-conductor luminescence equipment characterized by consisting of transparent poly meta ROKISANGERU which solidified the liquefied ceramic-coating agent which makes meta-ROKISAN association a subject.
[Claim 2] Said semi-conductor light emitting device is semi-conductor luminescence equipment according to claim 1 which generates the near ultraviolet ray of 365nm - 400nm of emission peak wavelengths which have a gallium nitride system compound semiconductor layer.
[Claim 3] Said fluorescence layer is semi-conductor luminescence equipment according to claim 1 or 2 which covers the perimeter of said semi-conductor light emitting device.
[Claim 4] Said fluorescence layer is semi-conductor luminescence equipment according to claim 1 or 2 formed in the inside of said cup section.
[Claim 5] Semi-conductor luminescence equipment given in claims 1 and 2 by which the light-scattering layer which mixes the light generated from said semi-conductor light emitting device and the light in which wavelength conversion was carried out by said fluorescence layer was prepared in said cup circles, or any 1 term of 4.
[Claim 6] Said light-scattering layer is semi-conductor luminescence equipment according to claim 5 which solidifies said ceramic-coating agent which mixed the transparence resin or the ceramic powder which mixed ceramic powder, and is formed.
[Claim 7] Said ceramic-coating agent is semi-conductor luminescence equipment given in any 1 term of claims 1-6 which are the liquefied sols which made the subject the metallic-oxide polymer obtained by carrying out hydrolysis condensation polymerization of inorganic and the organic complex which embellished a part of functional group of the single metal alkoxide which consists of a single metallic element, the compound metal alkoxide which consists of two or more metallic elements, a single metal alkoxide, or a compound metal alkoxide, and introduced the organic resin monomer.
[Claim 8] Said ceramic-coating agent is semi-conductor luminescence equipment given in any 1 term of claims 1-6 which are the liquefied sols which make polysilazane a subject.
[Claim 9] Said ceramic-coating agent is semi-conductor luminescence equipment given in any 1 term of claims 1-6 which are the liquefied sols which make a subject the compound ultrafine particle-like metallic oxide which consists of the single ultrafine particle-like metallic oxide or two or more metallic elements which consist of the single metallic element which has the diameter of about 5nm - 50nm generated by the flame hydrolysis which burns the mixture of gas of metal chloride gas and hydrogen, and oxygen at an elevated temperature.
[Claim 10] The adhesives which paste up said semi-conductor light emitting device on said cup section are semi-conductor luminescence equipment given in any 1 term of claims 1-9 which are the light transmission nature inorganic system adhesives which use as a start raw material the light transmission nature paste which mixed light transmission nature ceramic powder to the thermosetting organic resin which consists of the thermosetting conductive paste which consists of the 1 acidity-or-alkalinity epoxy resin which mixed minute foil, and a 1 acidity-or-alkalinity epoxy resin, said metal alkoxide, or said ultrafine particle-like metallic oxide.
[Claim 11] Said closure object is semi-conductor luminescence equipment given in any 1 term of claims 1-10 which consist of inorganic [which embellished a part of functional group of the organic resin which has light transmission nature, or said metal alkoxide, and introduced the organic resin monomer], or an organic complex polymer.
[Claim 12] Said closure object is semi-conductor luminescence equipment given in any 1 term of claims 1-11 containing an ultraviolet ray absorbent.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to semi-conductor luminescence equipment, especially the semi-conductor luminescence equipment which carries out wavelength conversion and emits to the light the near-ultraviolet light irradiated from a semi-conductor light emitting device outside.
[0002]
[Description of the Prior Art] The conventional fluorescent substance wavelength conversion semi-conductor luminescence equipment shown in drawing 6 wiring of a pair -- a conductor (1 2) and wiring of a pair -- with the cup section (3) prepared in one edge of a conductor (1 2) wiring of the semi-conductor light emitting device (4) which fixed at the pars basilaris ossis occipitalis of the cup section (3), a semi-conductor light emitting device (4), and a pair -- with the bonding wire (6 7) which connects a conductor (1 2) Coating which consists of the resin containing the fluorescent substance (9) which fills the inside of the cup section (3) and covers a semi-conductor light emitting device (4) (11), wiring of a pair -- it has the mold member (12) which consists of the transparence resin which covers one edge, cup section (3), semi-conductor light emitting device (4), bonding wire (6 7), and coating (11) of a conductor (1 2).
[0003] A semi-conductor light emitting device (4) is a semi-conductor light emitting device of the blue system which consists of the GaN system compound semiconductor which peak wavelength is in 400nm - 530nm, and has a monochromatic emission spectrum. A fluorescent substance (9) is expressed with chemical formula (RE1-xSmx) 3 (AlyGa1-y)5O12:Ce, and as being chosen from Y and Gd, 0<=x<1, 0<=y<=1, and RE are kinds as it is few. A fluorescent substance (9) is excited by the light emitted from a semi-conductor light emitting device (4), and emits light by the spectrum broad from a blue region to a red region as with a peak of a yellow region. On these specifications, a fluorescent substance (9) is written as a "YAG:Ce system fluorescent substance."
[0004] After mixing the powder of a YAG:Ce system fluorescent substance (9) to transparence resin, for example, pouring transparence resin into the cup section (3) using approaches, such as dispensing and PURIDIPPU, coating (11) carries out heat hardening of the transparence resin, and is formed. Although a part of luminescence component irradiated from a semi-conductor light emitting device (4) is absorbed with the YAG:Ce system fluorescent substance (9) under coating (11) and it is changed into the luminescence component of a YAG:Ce system fluorescent substance (9) with the semi-conductor luminescence equipment shown in drawing 6 The remainder of the luminescence component irradiated from a semi-conductor light emitting device (4) In order not to carry out incidence to a YAG:Ce system fluorescent substance (9) but to penetrate coating (11), the light emitted to the exterior of semi-conductor luminescence equipment turns into light to which color mixture of the luminescence component of a YAG:Ce system fluorescent substance (9) and the transmitted light component of the semi-conductor light emitting device (4) of a blue system was carried out.
[0005] Moreover, since the light of a semi-conductor light emitting device (4) and the light of a YAG:Ce system fluorescent substance (9) have the relation of the complementary color which sandwiches the white point of xy chromaticity diagram, if the concentration of the YAG:Ce system fluorescent substance (9) under coating (11) and the injection rate to the cup section (3) of coating (11) are appropriately controlled by the semi-conductor luminescence equipment shown in drawing 6 , the white light with the emission spectrum of a broadband can be emitted outside. Drawing 7 shows an example of the emission spectrum of the semi-conductor luminescence equipment shown in drawing 6 . It is strong to a mechanical shock, there is little generation of heat, and its high-voltage drive is unnecessary, and it does not generate a RF noise, but the semi-conductor luminescence equipment which emits the white light compared with the conventional sources of luminescence, such as an incandescent lamp which is a source of the bulb type white light, hot cathode fluorescence tubing, and cold-cathode fluorescence tubing, has a long life, has the advantage which was [be / it / environment-friendly] excellent without mercury, and is expected especially as a source of the next-generation solid state white light.
[0006] However, to conventional semi-conductor luminescence equipment with the outstanding advantage, since many problems are in coincidence, various trouble arises in the manufacture and application.
[0007]
[Problem(s) to be Solved by the Invention] When using it for the light sources for displays, such as a transparency mold color liquid crystal display with which a sharp emission spectrum is demanded, for example, since color purity is bad, the first problem which accompanies conventional semi-conductor luminescence equipment is in the fault which cannot display skillful color. That is, in the transparency mold color liquid crystal display, three-wave cold

cathode fluorescence tubing which usually has a sharp emission spectrum is used as a source of the white light. Drawing 8 shows an example of the emission spectrum of three-wave cold cathode fluorescence tubing. The transparency spectrum of the three-primary-colors color filter of the blue which constitutes each pixel of a transparency mold color liquid crystal display, green, and red is not sharp, and only in the transparency property of a color filter, since the high color expression of color purity is not expectable, three-wave cold cathode fluorescence tubing is used for the source of the white light of a transparency mold color liquid crystal display. A transparency spectrum has the transparency spectrum of a quite broad wavelength field so that clearly from drawing 9 which shows an example of the transparency spectrum of a color filter. Therefore, in a transparency mold color liquid crystal display, in order that the transmitted light spectrum of the three primary color each pixel of blue, green, and red may be determined by the emission spectrum of three-wave cold cathode fluorescence tubing in practice and may prevent mixing of other 2 primary-color components (for example, green and blue) to a 1-pixel transmitted light spectrum (for example, red), a color filter has only the role which shades in the rough range.

[0008] However, that there is no other way but to transmitted light determine [of each pixel used for a transparency mold color liquid crystal display / of a color filter / transparency] since the source of the white light of conventional semi-conductor luminescence equipment has the very broad emission spectrum of a YAG:Ce system fluorescent substance (9), since color purity cannot express bad skillful color even if it constitutes a display, conventional semi-conductor luminescence equipment does not fit the source of the white light of a transparency mold color liquid crystal display.

[0009] the concentration of the fluorescent substance (9) with which the second problem produced to conventional semi-conductor luminescence equipment is mixed during the injection rate of coating (11), and coating (11) — the cup section -- (-- the difficulty generated with [big] a color tone rose is in the luminescent color as the whole indicating equipment which becomes uneven at every 3) and consists of much semi-conductor luminescence equipments. In case conventional semi-conductor luminescence equipment is manufactured, the semi-conductor light emitting device (4) of a blue system is fixed at the pars basilaris ossis occipitalis of the cup section (3), optimum dose mixing of the powder of a YAG:Ce system fluorescent substance (9) is carried out at liquefied transparence resin, heat hardening of the transparence resin of optimum dose is poured in and carried out to the cup section (3) by approaches, such as dispensing or PURIDIPPU, and coating (11) is formed. Usually, it is difficult to pour in the transparence resin of a constant rate correctly into the cup section (3) which has about about 1/10,000 cc and the very minute volume. Moreover, the YAG:Ce system fluorescent substance (9) with about 4.8-4.9 and very large specific gravity tends to sediment within dispensing or PURIDIPPU equipment. consequently, the injection rate of coating (11) and the concentration of the YAG:Ce system fluorescent substance (9) under coating (11) — the cup section -- (-- it becomes uneven at every 3), the balance of the amount of blue transmitted lights of a semi-conductor light emitting device (4) and the amount of luminescence of a YAG:Ce system fluorescent substance (9) collapses, and it increases with [of synchrotron orbital radiation] a color tone rose as the whole indicating equipment. As shown in drawing 10 , the chromaticity of conventional semi-conductor luminescence equipment is large with a color tone rose, when semi-conductor luminescence equipment conventional with the indicating equipment of the structure which turns on two or more luminescence equipments which are broadly distributed from a blue region to a yellow region centering on a white region, and which were sake [equipments] for example, juxtaposed is used, and the problem to which display grace falls arises.

[0010] The third problem accompanying conventional semi-conductor luminescence equipment is in the point which produces big color tone nonuniformity in the synchrotron orbital radiation to each angle-of-beam-spread direction from a side face to a transverse plane. Since the viscosity of the resin which constitutes coating (11) falls greatly over long duration comparatively in case heat hardening of the coating (11) poured into the cup section (3) is carried out, the YAG:Ce system fluorescent substance with large specific gravity (9) sediments in coating (11), and is deposited on the pars basilaris ossis occipitalis of the cup section (3), and a semi-conductor light emitting device (4).

[0011] Drawing 11 is the fragmentary sectional view of the conventional semi-conductor luminescence equipment in which the sedimentation condition of a YAG:Ce system fluorescent substance (9) is shown. Although the synchrotron orbital radiation from the pars basilaris ossis occipitalis of the cup section (3) with the high concentration of the YAG:Ce system fluorescent substance (9) which sedimented, and a blue system semi-conductor light emitting device (4) top face wears the yellow taste, the synchrotron orbital radiation from the blue system semi-conductor light emitting device (4) side face where the concentration of a YAG:Ce system fluorescent substance (9) is low wears blueness. For this reason, if the synchrotron orbital radiation of conventional semi-conductor luminescence equipment is projected on a wall surface etc., the color tone nonuniformity of the shape of a ring located in a line in order of yellow, blue, and yellow toward the outside from the core of synchrotron orbital radiation is observable. It follows, for example, if conventional semi-conductor luminescence equipment is used for the application of the back light which expands and displays synchrotron orbital radiation, color tone nonuniformity will serve as a low grace display greatly.

[0012] The fourth problem derived to conventional semi-conductor luminescence equipment is in the point that the color tone nonuniformity which is the color tone rose and the third problem which are the second problem is amplified inevitably. If there are many the concentration or the injection rates of a YAG:Ce system fluorescent substance (9) in case the light to which color mixture of the luminescence component of a YAG:Ce system fluorescent substance (9) and the transmitted light component of a blue system semi-conductor light emitting device (4) was carried out is emitted outside for example Although the rate in which the light emitted from the blue

system semi-conductor light emitting device (4) carries out incidence to a YAG:Ce system fluorescent substance (9) becomes large and luminescence of a YAG:Ce system fluorescent substance (9) increases, as for the synchrotron orbital radiation of the blue system semi-conductor light emitting device (4) which penetrates coating (11) to coincidence, only the part decreases. On the contrary, if there are few the concentration or the injection rates of a YAG:Ce system fluorescent substance (9), the synchrotron orbital radiation of the blue system semi-conductor light emitting device (4) which penetrates coating (11) will increase. Thus, as for the luminescence component of a YAG:Ce system fluorescent substance (9), and the transmitted light component of a blue semi-conductor light emitting device (4), if one side increases, another side has the relation which decreases relatively. Therefore, with conventional semi-conductor luminescence equipment, if it changes even when the injection rate of coating (11) and the concentration of the fluorescent substance (9) under coating (11) are slight, the color tone of the synchrotron orbital radiation generated by color mixture will be changed sharply. Thus, while the luminescence component of a semi-conductor light emitting device (4) is the excitation light of a YAG:Ce system fluorescent substance (9), it cannot fully employ the advantage efficiently with conventional semi-conductor luminescence equipment because of the principle of operation which becomes the component of color mixture light.

[0013] In short, conventional semi-conductor luminescence equipment must solve the following problem.

[1] When using it for the light source of the display with which a sharp emission spectrum is demanded, color purity cannot express bad skillful color.

[2] With the uneven concentration of the injection rate of coating (11), and the fluorescent substance (9) under coating (11), it is generated with [big] a rose in the luminescent color tone of the whole indicating equipment.

[3] The color tone nonuniformity of the luminescent color to each angle-of-beam-spread direction from a side face to a transverse plane is large.

[4] It is easy to be amplified with a color tone rose from the problem on the principle of operation.

[0014] Then, a color expression sharp [an emission spectrum] and skillful is possible, and this invention aims at offering little semi-conductor luminescence equipment with a chromaticity rose. Moreover, this invention aims at it being long lasting, and being able to operate and offering environment-friendly semi-conductor luminescence equipment without mercury. Furthermore, it is strong to a mechanical shock, there is little generation of heat, the high voltage is unnecessary, and this invention aims at offering the semi-conductor luminescence equipment which does not generate a RF noise.

[0015]

[Means for Solving the Problem] the semi-conductor luminescence equipment by this invention -- wiring of a pair -- a conductor (1 2) and wiring of a pair -- with the cup section (3) formed in one edge of a conductor (1 2) it pastes up in the cup section (3) -- having -- and wiring -- with the semi-conductor light emitting device (4) which is electrically connected to a conductor (1 2) and generates near-ultraviolet light the fluorescence layer (10) prepared in the perimeter of a semi-conductor light emitting device (4), a semi-conductor light emitting device (4) and a bonding wire (6 7), and wiring -- it has the transparent closure object (8) which covers one edge and fluorescence layer (10) of a conductor. A fluorescence layer (10) contains the fluorescent substance (9) more than a kind which emits the light of wavelength which is excited by the near-ultraviolet light irradiated from a semi-conductor light emitting device (4), and is different from luminescence of a semi-conductor light emitting device (4). Moreover, a fluorescence layer (10) consists of transparent poly meta ROKISANGERU which solidified the liquefied ceramic-coating agent which makes meta-ROKISAN association a subject. By carrying out wavelength conversion of the near-ultraviolet light of a semi-conductor light emitting device (4) in a fluorescence layer (10) with a very sharp peak, since acutance is high, compared with conventional semi-conductor luminescence equipment, a color expression sharp [an emission spectrum] and skillful is possible for the emission spectrum of near-ultraviolet light generated from a semi-conductor light emitting device (4), and there are with a chromaticity rose. [few] Moreover, since the fluorescent substance (9) of the plurality excited by the near-ultraviolet light of a semi-conductor light emitting device (4) is mixable into a fluorescence layer (10), the fluorescent substance (9) corresponding to the property of requests, such as an emission spectrum, can be chosen. In order to use poly meta ROKISANGERU with high ultraviolet-rays resistance for the fluorescence layer (10) which encloses a fluorescent substance (9), degradation does not occur in a fluorescence layer (10), but mechanical strengths, such as an impact, improve. Moreover, if a fluorescent substance (9) with a spectrum with sharp blue, green, and red is combined, the source of the white light which can express the skillful color which was excellent in color purity is realizable. Since it is hardly checked by looking by the observer but the color tone of synchrotron orbital radiation is determined only of the luminescence component of a fluorescent substance (9) in order to excite a fluorescent substance (9) by near-ultraviolet light, even when the injection rate and concentration of a fluorescent substance (9) are uneven, it does not happen with [of a color tone] a rose.

[0016] With the gestalt of operation of this invention, a semi-conductor light emitting device (4) generates the near ultraviolet ray of 365nm - 400nm of emission peak wavelengths which have a gallium nitride system compound semiconductor layer. Since the perimeter of a semi-conductor light emitting device (4) is covered with the fluorescence layer (10) prepared in the inside of the cup section (3), after all the light generated from a semi-conductor light emitting device (4) passes a fluorescence layer (10), they is emitted outside through a closure object (8).

[0017] Since the light-scattering layer (13) which mixes the light generated from a semi-conductor light emitting device (4) and the light in which wavelength conversion was carried out by the fluorescence layer (10) is prepared in the cup section (3), mixing of sufficient light is performed by the light-scattering layer (13). A light-scattering layer

(13) solidifies the ceramic-coating agent which mixed the transparence resin or the ceramic powder which mixed ceramic powder, and is formed. A ceramic-coating agent is a liquefied sol which makes a subject the liquefied sol which made the subject the metallic-oxide polymer obtained by carrying out hydrolysis condensation polymerization of inorganic and the organic complex which embellished a part of functional group of the single metal alkoxide which consists of a single metallic element, the compound metal alkoxide which consists of two or more metallic elements, a single metal alkoxide, or a compound metal alkoxide, and introduced the organic resin monomer, or polysilazane.
[0018] A ceramic-coating agent is a liquefied sol which makes a subject the compound ultrafine particle-like metallic oxide which consists of the single ultrafine particle-like metallic oxide or two or more metallic elements which consist of the single metallic element which has the diameter of about 5nm - 50nm generated by the flame hydrolysis which burns the mixture of gas of metal chloride gas and hydrogen, and oxygen at an elevated temperature.
[0019] The adhesives (5) which paste up a semi-conductor light emitting device (4) on the cup section (3) are the light transmission nature inorganic system adhesives which used as the start raw material the light transmission nature paste, metal alkoxide, or ultrafine particle-like metallic oxide which mixed light transmission nature ceramic powder to the thermosetting organic resin which consists of the thermosetting conductive paste which consists of the 1 acidity-or-alkalinity epoxy resin which mixed minute foil, and a 1 acidity-or-alkalinity epoxy resin. A closure object (8) consists of inorganic [which embellished a part of functional group of the organic resin which has light transmission nature, or a metal alkoxide, and introduced the organic resin monomer], or an organic complex polymer. A closure object (8) may contain an ultraviolet ray absorbent.
[0020]
[Embodiment of the Invention] Hereafter, the gestalt of operation of the semi-conductor luminescence equipment by this invention is explained about drawing 1 - drawing 4 . Drawing 1 shows the fragmentary sectional view of the gestalt of the first operation by the semi-conductor luminescence equipment by this invention. the semi-conductor luminescence equipment of this example -- wiring of a pair -- a conductor (1 2) and wiring of a pair -- with the cup section (3) formed in one edge of a conductor (1 2) The semi-conductor light emitting device pasted up with adhesives (5) in the cup section (3) (4), the first electrode of a semi-conductor light emitting device (4) and the second electrode, and wiring of a pair -- with the bonding wire (6 7) which connects one edge of a conductor (1 2) the fluorescence layer (10) prepared in the perimeter of a semi-conductor light emitting device (4), a semi-conductor light emitting device (4) and a bonding wire (6 7), and wiring -- it has the transparent closure object (8) which covers one edge and fluorescence layer (10) of a conductor (1 2). A fluorescence layer (10) consists of transparent poly meta ROKISANGERU which solidified the liquefied ceramic-coating agent which makes meta-ROKISAN association a subject, including the fluorescent substance (9) more than a kind which emits the light of wavelength which is excited by the near-ultraviolet light irradiated from a semi-conductor light emitting device (4), and is different from the luminescence wavelength of a semi-conductor light emitting device (4).
[0021] A semi-conductor light emitting device (4) is constituted by the InGaN system semi-conductor light emitting device which generates the near-ultraviolet light of 390nm of emission peak wavelengths. A semi-conductor light emitting device (4) is a near-ultraviolet semi-conductor light emitting device whose emission peak wavelength which has gallium nitride system compound semiconductor layers formed by single crystal grown methods, such as epitaxial growth, on ceramic substrates, such as semi-conductor substrates, such as SiC, or sapphire, such as InGaN and GaN, is 365nm - 400nm.
[0022] A fluorescence layer (10) mixes three sorts of fluorescence ingredients, blue, green, and red, by the predetermined ratio to the ceramic-coating agent which uses a metal alkoxide as a start raw material, forms mixture, and is formed by applying and stiffening mixture in the cup section (3) to which the semi-conductor light emitting device (4) was fixed. Three sorts of fluorescence ingredients which constitute a fluorescent substance (9) are mixed by the predetermined ratio which generates the white light.
[0023] A fluorescence layer (10) consists of poly meta ROKISANGERU which solidified the liquefied ceramic-coating agent which makes a subject meta-ROKISAN association (M-O-M association, M: metal), including the fluorescent substance (9) more than a kind which emits the light of wavelength which is excited by the near-ultraviolet light irradiated from a semi-conductor light emitting device (4), and is different from luminescence of a semi-conductor light emitting device (4). Poly meta ROKISANGERU has light transmission nature to the near-ultraviolet light irradiated from a semi-conductor light emitting device (4), and has thermal resistance and ultraviolet-rays resistance. Therefore, as a component of the fluorescence layer (10) of the semi-conductor luminescence equipment of this invention, it is the optimal.
[0024] A ceramic-coating agent processes a metallic-oxide polymer into the liquefied sol made into a subject by the approach of showing start raw materials, such as a metal alkoxide, polysilazane, and an ultrafine particle-like metallic oxide, below, respectively.
[0025] it comes out, and it is chemical formula M(OR) n, M:metal, R:alkyl group, and the organometallic compound expressed, for example, a metal alkoxide is the single metal alkoxide which consists of single metallic elements, such as silicon, aluminum, titanium, and a zirconium, or a compound metal alkoxide which consists of two or more metallic elements. Moreover, it is also possible to use inorganic and the organic complex which embellished a part of functional group of a metal alkoxide, and introduced the organic resin monomer.
[0026] A metal alkoxide is distributed to solvents, such as alcohol, and if water and the catalyst of a minute amount are dropped and it mixes, the hydrolysis condensation reaction shown with the following chemical formula will be produced.

M(OR) n+xH2O->M(OH)x(OR) n-x+xROH(-M-OH)+(H-O-M)->(-M-O-M)+H2O(-M-OH)+(R-O-M)->(-M-O-M)+ROH
[0027] The liquefied sol which changed into the condition that the polymer of a metallic oxide distributed to the solvent when the reaction was stopped on the way, by the above-mentioned reaction although the polymer of a metallic oxide arose in the solvent is obtained, and it can use as a ceramic-coating agent.
[0028] Polysilazane is the inorganic compound which made chemical formula-SiH2-NH- basic structure, introduces ammonia into the complex of dichlorosilane and a pyridine, and is compounded. The liquefied sol which diluted polysilazane with suitable solvents, such as a xylene, can be used as a ceramic-coating agent.
[0029] An ultrafine particle-like metallic oxide is the single ultrafine particle-like metallic oxide which consists of single metallic elements, such as silicon, aluminum, titanium, and a zirconium, or a compound ultrafine particle-like metallic oxide which consists of two or more metallic elements, and is metallic-oxide pulverized coal whose diameter generated by the flame hydrolysis which burns the mixture of gas of metal chloride gas and hydrogen, and oxygen at an elevated temperature is about 5nm - 50nm. Solvents, such as alcohol, are made to distribute an ultrafine particle-like metallic oxide, and if water is dropped and it mixes, a liquefied sol is obtained and it can use as a ceramic-coating agent.
[0030] After mixing a powder-like fluorescent substance (9) to a ceramic-coating agent, pouring into the cup section (3) which the semi-conductor light emitting device (4) pasted up with adhesives (5) beforehand by approaches, such as dispensing and PURIDIPPU, leaving it in air and volatilizing a solvent, heat hardening of the fluorescence layer (10) of the first semi-conductor luminescence equipment by this invention is carried out, and it is formed. Moreover, the fluorescence layer (10) of the second semi-conductor luminescence equipment by this invention mixes a powder-like fluorescent substance (9) to a ceramic-coating agent, and after applying to the inside of the cup section (3) thinly, leaving it in air and volatilizing a solvent by approaches, such as dispensing and PURIDIPPU, heat hardening of it is carried out and it is formed.
[0031] A closure object (8) consists of inorganic and the organic complex polymer into which a part of functional group of organic resin, such as an epoxy resin which has light transmission nature, silicone resin, polyester resin, and acrylic resin, or a metal alkoxide was embellished, and the organic resin monomer was introduced, and is formed by approaches, such as potting and injection molding. In order for the near-ultraviolet light of a semi-conductor light emitting device (4) to protect degradation of a closure object (8), an ultraviolet ray absorbent may be added on a closure object (8).
[0032] After a light-scattering layer (13) carries out optimum dose mixing and pours ceramic powder, such as a silica, an alumina, and titanium oxide, into the cup section (3) by approaches, such as dispensing and PURIDIPPU, it is solidified and formed in the same ceramic-coating agent as the ceramic-coating agent used for the same organic resin as a closure object (8), or a fluorescence layer (10) on predetermined hardening conditions. In addition, since a light-scattering layer (13) receives the near-ultraviolet light from a semi-conductor light emitting device (4), it is desirable to choose a ceramic-coating agent as a component for preventing degradation of a light-scattering layer (13).
[0033] A bonding wire (6 7) is a metal thin line which consists of gold, silver, aluminum, copper, etc. Adhesives (5) are the light transmission nature inorganic system adhesives which used as the start raw material the light transmission nature paste which mixed light transmission nature ceramic powder to the thermosetting conductive paste which consists of the 1 acidity-or-alkalinity epoxy resin which mixed very small foil, such as gold and silver, or the thermosetting organic resin which consists of a 1 acidity-or-alkalinity epoxy resin, the metal alkoxide, or the ultrafine particle-like metallic oxide.
[0034] wiring of the pair containing the cup section (3) in which the semiconductor device (4) and the fluorescence layer (10) were formed -- the edge of a conductor (1 2) -- the inside of a pot -- holding -- wiring of a pair -- a closure object (8) is formed by the potting method make the perimeter of a conductor (1 2) fill up with and harden a transparent bisphenol system epoxy resin. Although an ultraviolet ray absorbent is not added by the closure object (8), you may add if needed. Table 1 shows many properties of a fluorescent substance (9).
[0035]
[Table 1]

発光色	組成	発光ピーク波長	比重
青色	$Sr_5(PO_4)3Cl:Eu$	445nm	4.15
緑色	$3(Ba,Mg)O\cdot 8Al_2O_3:Eu,Mg$	514nm	3.8
赤色	$Y_2O_2S:Eu$	624nm	5.1

[0036] As the emission spectrum of the semi-conductor luminescence equipment of the gestalt of operation by this invention is shown in drawing 3 to the emission spectrum with very wide width of face having been generated with conventional semi-conductor luminescence equipment as shown in drawing 7 , acutance of the description is high with a very sharp peak. Since the emission spectrum of three-wave cold cathode fluorescence tubing shown in drawing 8 is resembled, the semi-conductor luminescence equipment by this invention can also be used for a transparency mold color liquid crystal display as a source of the white light replaced with three-wave cold cathode fluorescence tubing. Although a peak occurs to five different wavelength fields as shown in drawing 3 , as for the peak by the side of short wavelength, the transmitted light component from a semi-conductor light emitting device (4) is shown most, and other four peaks are luminescence of each fluorescent substance (9) shown in Table 1. Moreover, the small peak of red fluorescent substance (9) Y2O2 S:Eu is seen 700nm near wavelength. Although the transmitted light component from a semi-conductor light emitting device (4) is strongly irradiated as shown in

drawing 3 ,if the near-ultraviolet light from a semi-conductor light emitting device (4) is enough absorbed by optimizing each quality of the material and the amount of each of a fluorescence layer (10), or adding an ultraviolet ray absorbent on a closure object (8), the near-ultraviolet quantity of light can be decreased to the level which is satisfactory practically. Compared with the chromaticity distribution shown in drawing 10 of conventional semi-conductor luminescence equipment, as chromaticity distribution of the semi-conductor luminescence equipment by this invention is shown in drawing 4 , width of face with a rose is very narrow, and has the outstanding property.

[0037] Although the specific gravity of the blue and the green fluorescent substance (9) which are used for the gestalt of this operation to the specific gravity 4.8-4.9 of the YAG:Ce system fluorescent substance used for conventional semi-conductor luminescence equipment is small, since the specific gravity of a red fluorescent substance (9) is large a little, the amount of sedimentation of a red fluorescent substance (9) is large compared with the amount of sedimentation of a YAG:Ce system fluorescent substance. As opposed to the conventional semi-conductor luminescence equipment which uses luminescence of a blue system semi-conductor light emitting device (4) also [component / of semi-conductor luminescence equipment itself / a part for excitation Mitsunari of a fluorescent substance, and / luminescence] with the semi-conductor luminescence equipment of this invention Since the near-ultraviolet light which excites a fluorescent substance (9) is hardly checked by looking by the observer, although its specific gravity of a red fluorescent substance (9) is larger than the specific gravity of a YAG:Ce system fluorescent substance, the color tone of the synchrotron orbital radiation of the semi-conductor luminescence equipment by this invention is determined only of the luminescence component of a fluorescent substance (9). Therefore, compared with the former, the direction of the gestalt of operation by this invention is considered to become small whether you are Haruka with a chromaticity rose.

[0038] Since the light of wavelength according to the energy gap which the semi-conductor which generally constitutes a semi-conductor light emitting device (4) has is emitted, unless the presentation of a semi-conductor light emitting device is changed, luminescence wavelength is unchangeable, but while the same semi-conductor light emitting device (4) is used for the semi-conductor luminescence equipment by this invention, the class of fluorescent substance (9) and the combination to be used can be changed, various color tones can create, and the application range is large high semi-conductor luminescence equipment of commodity value.

[0039] Moreover, the gestalt of operation of the 2nd of the semi-conductor luminescence equipment by this invention is shown in drawing 2 . The fluorescence layer with which the semi-conductor luminescence equipment by the gestalt of the second operation covers the inside of the cup section (3) (10), The light-scattering layer which covers a semi-conductor light emitting device (4) and a fluorescence layer (10) (13), a semi-conductor light emitting device (4), a bonding wire (6 7), and wiring -- it consists of the transparent closure object (8) which covers one edge, fluorescence layer (10), and light-scattering layer (13) of a conductor, and other configurations are the same as drawing 1 .

[0040] in addition, although not illustrated especially, as a gestalt of others of the semi-conductor luminescence equipment by this invention wiring of a pair -- a conductor (1 2) and wiring of a pair -- with the cup section (3) gone across and prepared for the both sides of one edge of a conductor (1 2) The semi-conductor light emitting device which the first electrode prepared on the same flat surface and the second electrode pasted up on the cup section (3) through a metal bump or electroconductive glue (4), wiring of the fluorescence layer (10) which covers the inside of the cup section (3), or the perimeter of a semi-conductor light emitting device (4), a semi-conductor light emitting device (4) and a metal bump or electroconductive glue, and a pair -- it can also constitute from a transparent closure object (8) which covers one edge and fluorescence layer (10) of a conductor (1 2). The semi-conductor luminescence equipment by this invention can also consist of so-called flip chip structures.

[0041] Compared with conventional semi-conductor luminescence equipment, the semi-conductor luminescence equipment by this invention has the description which was excellent in the following. First, since the first description of the semi-conductor luminescence equipment by this invention mixes in a fluorescence layer (10) the fluorescent substance (9) of the varieties excited by the near-ultraviolet light of the semi-conductor light emitting device (4) to which an emission peak wavelength exists in a 365nm - 400nm wavelength field, it is that it can choose the fluorescent substance (9) corresponding to the property of a request of an emission spectrum etc. There are very few fluorescent substances which can generally be excited by the light, and the fluorescent substance which can be excited with short wavelength from a near-ultraviolet region is almost the case. It can excite by 400nm - 530nm which is the peak wavelength range of the semi-conductor light emitting device of a blue system used for the excitation light source of conventional semi-conductor luminescence equipment, and there is almost no practical fluorescent substance with little degradation in practice in addition to a YAG:Ce system fluorescent substance.

[0042] The second description of the semi-conductor luminescence equipment by this invention is the point of using poly meta ROKISANGERU with high ultraviolet-rays resistance for the fluorescence layer (10) which encloses a fluorescent substance (9). With conventional semi-conductor luminescence equipment, since the resin used as coating containing a YAG:Ce system fluorescent substance will deteriorate if ultraviolet rays are received, it cannot use the semi-conductor light emitting device (4) which generates near-ultraviolet light.

[0043] The third description of the semi-conductor luminescence equipment by this invention is the point that the source of the white light which can express the skillful color which was excellent in color purity is realizable. In order to use a YAG:Ce system fluorescent substance with the very wide width of face of an emission spectrum, the conventional semi-conductor luminescence equipment with which color purity cannot express bad skillful color does not fit the application of a transparency mold color liquid crystal display.

[0044] On the other hand, the same spectrum distribution as cold cathode fluorescence tubing is acquired, and the

semi-conductor luminescence equipment by this invention can realize the source of the white light which can express the skillful color which was excellent in color purity, if a fluorescent substance (9) with a spectrum with sharp blue, green, and red is combined.

[0045] The fourth description of the semi-conductor luminescence equipment by this invention is a point with little a color tone rose and color tone nonuniformity theoretically. Conventional semi-conductor luminescence equipment has the principle of operation which uses luminescence of a blue system semi-conductor light emitting device also [component / of the excitation light of a YAG:Ce system fluorescent substance, and the synchrotron orbital radiation of conventional semi-conductor luminescence equipment itself / one]. For this reason, even when the injection rate of coating and the concentration of the YAG:Ce system fluorescent substance under coating are slight, the color tone of rose **** and the synchrotron orbital radiation of conventional semi-conductor luminescence equipment is rose **** greatly. Moreover, conventional semi-conductor luminescence equipment has the large color tone nonuniformity of the synchrotron orbital radiation in each angle-of-beam-spread direction from a side face to a transverse plane, when a YAG:Ce system fluorescent substance with large specific gravity sediments within the cup section (3).

[0046] With the semi-conductor luminescence equipment by this invention, since it is hardly checked by looking by the observer but the color tone of synchrotron orbital radiation is determined only of the luminescence component of a fluorescent substance (9) in order to excite a fluorescent substance (9) by near-ultraviolet light, even when the injection rate and concentration of a fluorescent substance (9) are uneven, it does not happen with [of a color tone] a rose. Moreover, similarly, even if sedimentation of a fluorescent substance (9) occurs within the cup section (3), the color tone nonuniformity of the synchrotron orbital radiation to each angle-of-beam-spread direction is not generated. Thus, the semi-conductor luminescence equipment by this invention can solve fundamentally many troubles which conventional semi-conductor luminescence equipment has, and more excellent semi-conductor luminescence equipment can be realized.

[0047] Drawing 5 shows the gestalt of the third operation by this invention applied to the chip form light emitting diode equipment which uses an insulating substrate. The insulating substrate with which chip form light emitting diode equipment serves as a base with which the cup section (3) was formed in one principal plane (14), the first wiring mutually estranged and formed in the insulating substrate (14) -- a conductor (1) and the second wiring -- with a conductor (2) the first wiring -- with the semi-conductor light emitting device (4) which fixed through adhesives (5) in the cup section (3) of a conductor (1) the anode electrode (4a) of a semi-conductor light emitting device (4), and the 1st wiring -- with the first bonding wire (6) which connects a conductor (1) electrically the cathode electrode (4b) of a semi-conductor light emitting device (4), and the 2nd wiring -- with the second bonding wire (7) which connects a conductor (2) electrically It fills up in the cup section (3). A semi-conductor light emitting device (4), an anode electrode (4a), The fluorescence layer which covers the edge of the bonding wire (6 7) connected to the cathode electrode (4b) and the anode electrode (4a), and the cathode electrode (4b) (10), It has the closure object (8) of the trapezoidal shape cross section which is formed in one principal plane of an insulating substrate (14), and covers the outside of a fluorescence layer (10). the 1st wiring -- a conductor (1) and the 2nd wiring -- one edge of a conductor (2) is arranged in the cup section (3). a semi-conductor light emitting device (4) -- the pars basilaris ossis occipitalis (3a) of the cup section (3) -- the 1st wiring -- it fixes through adhesives (5) to a conductor (1). the 1st wiring -- a conductor (1) and the 2nd wiring -- each other-end section of a conductor (2) is prolonged in the side face of an insulating substrate (14), and the principal plane of another side, and is arranged at them. A fluorescence layer (10) does not project from the upper limit section (3b) of the cup section (3). After the light irradiated from a semi-conductor light emitting device (4) passes through the inside of a fluorescence layer (10), it is emitted to the exterior of the closure object (8) which covers a fluorescence layer (10).

[0048] The light emitted from the semi-conductor light emitting device (4) reaches a fluorescence layer (10), wavelength conversion is carried out, different wavelength within a fluorescence layer (10) is mixed with a part for Mitsunari from the semi-conductor light emitting device (4) by which wavelength conversion is not carried out, and the part is emitted outside through a closure object (8). The binding material which prevents the crack of the light absorption matter which absorbs specific luminescence wavelength, the light-scattering matter (10b) scattered about in luminescence of a semi-conductor light emitting device (4), or a fluorescence layer (10) may be blended in a fluorescence layer (10).

[0049] The predominance of semi-conductor luminescence equipment according to this invention at any aforementioned point is clear. It does not pass over the gestalt of said operation to instantiation, and this invention is not limited to these. For example, if each fluorescent substance (9) of the blue shown in Table 1, green, and red is used independently, the semi-conductor luminescence equipment which emits the light of blue, green, and red, respectively will be obtained. Moreover, if two or more sorts of fluorescent substances (9) are combined with a suitable compounding ratio, the semi-conductor luminescence equipment which emits the light of the neutral colors according to the compounding ratio will be obtained.

[0050]

[Effect of the Invention] As mentioned above, since it has the description which was [light up / a color expression sharp / an emission spectrum / and skillful is possible, / compared with conventional semi-conductor luminescence equipment, / with / plurality is put in order with a chromaticity rose few and] excellent, the semi-conductor luminescence equipment by this invention is expected very much as the full-scale next-generation solid state light source replaced with the bulb type light source.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view showing the first semi-conductor luminescence equipment by this invention
[Drawing 2] The sectional view by this invention showing the gestalt of the second operation
[Drawing 3] The graph which shows the emission spectrum of the semi-conductor luminescence equipment by this invention
[Drawing 4] The graph which shows chromaticity distribution of the semi-conductor luminescence equipment by this invention
[Drawing 5] The sectional view showing the gestalt of operation of the third of this invention applied to the chip mold semi-conductor light emitting device
[Drawing 6] The sectional view showing conventional semi-conductor luminescence equipment
[Drawing 7] The graph which shows the emission spectrum obtained from conventional semi-conductor luminescence equipment
[Drawing 8] The graph which shows the emission spectrum of three-wave cold cathode fluorescence tubing
[Drawing 9] An example of the transparency spectrum of the color filter of a transparency mold color liquid crystal display
[Drawing 10] An example of chromaticity distribution of conventional semi-conductor luminescence equipment
[Drawing 11] The mimetic diagram of the sedimentation condition of the YAG:Ce system fluorescent substance of conventional semi-conductor luminescence equipment
[Description of Notations]
(1 2) .. wiring -- conductor (3) .. the cup section (4) .. semi-conductor light emitting device (5) .. adhesives (6 7) .. bonding wire (8) .. closure object (9) .. fluorescent substance (10) .. fluorescence layer (11) .. coating (12) .. a mold member and (13) .. optical diffusion layer,

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[Translation done.]

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(71)出願人　000106276
サンケン電気株式会社
埼玉県新座市北野３丁目６番３号

(72)発明者　佐野　武志
埼玉県新座市北野３丁目６番３号　サンケン電気株式会社内

(74)代理人　100082049
弁理士　清水　敏一

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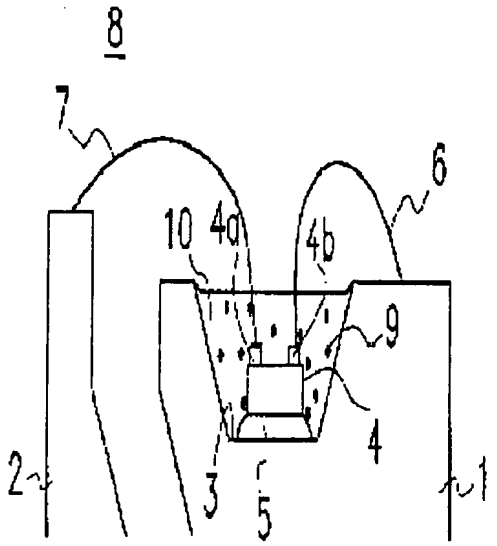
(54)【発明の名称】　半導体発光装置

(57)【要約】
【課題】　半導体発光装置の発光スペクトルを改善し、色度バラつきを減少する。
【解決手段】　半導体発光素子(4)の周囲に設けられた蛍光層(10)は、半導体発光素子(4)から照射される近紫外光によって励起され半導体発光素子(4)の発光と異なる波長の光を発する一種以上の蛍光体(9)を含み、かつメタロキサン結合を主体とする液状のセラミックコーティング剤を固化させた透明なポリメタロキサンゲルより成る。半導体発光素子(4)から発生する近紫外光の発光スペクトルは、非常に鋭利なピークを持ち尖鋭度が高いので、半導体発光素子(4)の近紫外光を蛍光層(10)で波長変換することにより、従来の半導体発光装置に比べ、発光スペクトルがシャープで鮮やかな色彩を表現できる。



【特許請求の範囲】

【請求項１】　一対の配線導体と、一対の該配線導体の一方の端部に形成されたカップ部と、前記カップ部内に接着され且つ前記配線導体に電気的に接続されて近紫外光を発生する半導体発光素子と、前記半導体発光素子の周囲に設けられた蛍光層と、前記半導体発光素子、ボンディングワイヤ、配線導体の一方の端部及び蛍光層とを被覆する透明な封止体とを備えた半導体発光装置において、

前記蛍光層は、前記半導体発光素子から照射される近紫外光によって励起され且つ前記半導体発光素子の発光波長と異なる波長の光を発する一種以上の蛍光体を含み、前記蛍光体層は、メタロキサン結合を主体とする液状のセラミックコーティング剤を固化させた透明なポリメタロキサンゲルより成ることを特徴とする半導体発光装置。

【請求項２】　前記半導体発光素子は、窒化ガリウム系化合物半導体層を有する発光ピーク波長３６５nm～４００nmの近紫外線を発生する請求項１に記載の半導体発光装置。

【請求項３】　前記蛍光層は、前記半導体発光素子の周囲を被覆する請求項１又は２に記載の半導体発光装置。

【請求項４】　前記蛍光層は、前記カップ部の内面に設けられた請求項１又は２に記載の半導体発光装置。

【請求項５】　前記半導体発光素子から発生する光と前記蛍光層により波長変換された光とを混合する光散乱層が前記カップ部内に設けられた請求項１、２又は４の何れか１項に記載の半導体発光装置。

【請求項６】　前記光散乱層は、セラミック粉末を混合した透明樹脂又はセラミック粉末を混合した前記セラミックコーティング剤を固化して形成される請求項５に記載の半導体発光装置。

【請求項７】　前記セラミックコーティング剤は、単一の金属元素より成る単一金属アルコキシド、複数の金属元素より成る複合金属アルコキシド又は単一金属アルコキシド若しくは複合金属アルコキシドの官能基の一部を修飾して有機樹脂モノマーを導入した無機・有機複合体を加水分解縮重合して得られる金属酸化物ポリマを主体とした液状のゾルである請求項１～６の何れか１項に記載の半導体発光装置。

【請求項８】　前記セラミックコーティング剤は、ポリシラザンを主体とする液状のゾルである請求項１～６の何れか１項に記載の半導体発光装置。

【請求項９】　前記セラミックコーティング剤は、金属塩化物ガス及び水素、酸素の混合気体を高温で燃焼させる火炎加水分解法によって生成された約５nm～５０nmの直径を有する単一の金属元素より成る単一超微粒子状金属酸化物又は複数の金属元素より成る複合超微粒子状金属酸化物を主体とする液状のゾルである請求項１～６の何れか１項に記載の半導体発光装置。

【請求項１０】　前記半導体発光素子を前記カップ部に接着する接着剤は、微小な金属薄片を混合した一液性エポキシ樹脂より成る熱硬化性導電ペースト、一液性エポキシ樹脂より成る熱硬化性有機樹脂に光透過性セラミック粉末を混合した光透過性ペースト、前記金属アルコキシド又は前記超微粒子状金属酸化物を出発原料とする光透過性無機系接着剤である請求項１～９の何れか１項に記載の半導体発光装置。

【請求項１１】　前記封止体は、光透過性を有する有機樹脂又は前記金属アルコキシドの官能基の一部を修飾して有機樹脂モノマーを導入した無機若しくは有機複合体ポリマーより成る請求項１～１０の何れか１項に記載の半導体発光装置。

【請求項１２】　前記封止体は、紫外線吸収剤を含有する請求項１～１１の何れか１項に記載の半導体発光装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は半導体発光装置、特に半導体発光素子から照射される近紫外光を可視光に波長変換して外部に放出する半導体発光装置に関する。

【０００２】

【従来の技術】図６に示す従来の蛍光体波長変換半導体発光装置は、一対の配線導体(1, 2)と、一対の配線導体(1, 2)の一方の端部に設けられたカップ部(3)と、カップ部(3)の底部に固着された半導体発光素子(4)と、半導体発光素子(4)と一対の配線導体(1, 2)とを接続するボンディングワイヤ(6, 7)と、カップ部(3)内を満たし半導体発光素子(4)を被覆する蛍光体(9)を含有する樹脂より成るコーティング(11)と、一対の配線導体(1, 2)の一方の端部、カップ部(3)、半導体発光素子(4)、ボンディングワイヤ(6, 7)及びコーティング(11)とを被覆する透明樹脂より成るモールド部材(12)とを備える。

【０００３】半導体発光素子(4)は、４００nm～５３０nm間にピーク波長があり且つ単色性の発光スペクトルを持つGaN系化合物半導体より成る青色系の半導体発光素子である。蛍光体(9)は、化学式$(RE_{1-x}Sm_x)_3(Al_yGa_{1-y})_5O_{12}:Ce$で表され、$0 \leq x < 1$、$0 \leq y \leq 1$、REはY、Gdから選択される少なくとも一種である。蛍光体(9)は、半導体発光素子(4)より放射される光によって励起され、黄色域をピークとして青色域から赤色域まで幅広いスペクトルで発光する。本明細書では、蛍光体(9)を「YAG：Ce系蛍光体」と略記する。

【０００４】コーティング(11)は、透明樹脂にYAG：Ce系蛍光体(9)の粉末を混合し、例えばディスペンスやプリディップ等の方法を用いてカップ部(3)に透明樹脂を注入した後、透明樹脂を加熱硬化して形成される。図６に示す半導体発光装置では、半導体発光素子(4)から照射される発光成分の一部は、コーティング(11)中のYAG：Ce系蛍光体(9)で吸収され、YAG：Ce系蛍光体(9)の発

光成分に変換されるが、半導体発光素子(4)から照射される発光成分の残部は、YAG：Ce系蛍光体(9)に入射せずコーティング(11)を透過するため、半導体発光装置の外部に放出される光は、YAG：Ce系蛍光体(9)の発光成分と青色系の半導体発光素子(4)の透過光成分とが混色された光となる。

【０００５】また、半導体発光素子(4)の光とYAG：Ce系蛍光体(9)の光とがｘｙ色度図の白色点を挟む補色の関係にあるために、図６に示す半導体発光装置ではコーティング(11)中のYAG：Ce系蛍光体(9)の濃度とコーティング(11)のカップ部(3)への注入量とを適切に制御すれば、広帯域の発光スペクトルを持つ白色光を外部に放出することができる。図７は、図６に示す半導体発光装置の発光スペクトルの一例を示す。管球式白色光源である白熱電球、熱陰極蛍光管、冷陰極蛍光管等従来の発光源に比べて、白色光を発する半導体発光装置は、機械的衝撃に強く、発熱が少なく、高電圧駆動が不要であり、高周波ノイズを発生せず、寿命が長く、水銀を使用せず環境に優しい等の優れた利点があり、次世代固体化白色光源として特に期待される。

【０００６】しかしながら、優れた利点を持つ従来の半導体発光装置には、同時に多くの問題があるために、その製造及び応用に当たり様々な支障が生ずる。

【０００７】

【発明が解決しようとする課題】従来の半導体発光装置に付随する第一の問題は、例えばシャープな発光スペクトルが要求される透過型カラー液晶表示装置等の表示装置用光源に使用する場合、色純度が悪いため、鮮やかな色彩を表示できない欠点にある。即ち、透過型カラー液晶表示装置では、通常、シャープな発光スペクトルを持つ三波長冷陰極蛍光管を白色光源として使用している。図８は、三波長冷陰極蛍光管の発光スペクトルの一例を示す。透過型カラー液晶表示装置の各画素を構成する青色、緑色及び赤色の三原色カラーフィルタの透過スペクトルがシャープでなく、カラーフィルタの透過特性のみでは色純度の高い色彩表現を期待できないため、透過型カラー液晶表示装置の白色光源に三波長冷陰極蛍光管が用いられる。カラーフィルタの透過スペクトルの一例を示す図９から明らかなように、透過スペクトルはかなり幅広い波長領域の透過スペクトルを持つ。従って、透過型カラー液晶表示装置では、青色、緑色及び赤色の各三原色画素の透過光スペクトルは、実際上三波長冷陰極蛍光管の発光スペクトルで決定され、一画素の透過光スペクトル（例えば、赤）に対する他の二原色成分（例えば、緑と青）の混入を防止するため、カラーフィルタは大まかな範囲で遮光するだけの役割を持つに過ぎない。

【０００８】しかしながら、従来の半導体発光装置の白色光源は、YAG：Ce系蛍光体(9)の発光スペクトルが非常に幅広いため、透過型カラー液晶表示装置に使用する各画素の透過光スペクトルをカラーフィルタの透過スペクトルで決定する他なく、この結果、従来の半導体発光装置は、表示装置を構成しても色純度が悪く鮮やかな色彩を表現できないため、透過型カラー液晶表示装置の白色光源には適さない。

【０００９】従来の半導体発光装置に生ずる第二の問題は、コーティング(11)の注入量及びコーティング(11)中に混入される蛍光体(9)の濃度がカップ部(3)毎に不均一となり、多数の半導体発光装置からなる表示装置全体として発光色に大きな色調バラつきが発生する難点がある。従来の半導体発光装置を製造する際に、カップ部(3)の底部に青色系の半導体発光素子(4)を固着し、YAG：Ce系蛍光体(9)の粉末を液状の透明樹脂に適量混合し、ディスペンス又はプリディップなどの方法によってカップ部(3)に適量の透明樹脂を注入し加熱硬化してコーティング(11)が形成される。通常約１万分の１cc程度と極めて微小な容積を有するカップ部(3)内に一定量の透明樹脂を正確に注入するのは困難である。また、約４．８～４．９と非常に大きい比重を持つYAG：Ce系蛍光体(9)は、ディスペンス又はプリディップ装置内で沈降しやすい。その結果、コーティング(11)の注入量とコーティング(11)中のYAG：Ce系蛍光体(9)の濃度とがカップ部(3)毎に不均一となり、半導体発光素子(4)の青色透過光量とYAG：Ce系蛍光体(9)の発光量とのバランスが崩れ、表示装置全体として放射光の色調バラつきが増大する。図１０に示すように、従来の半導体発光装置の色度は白色域を中心に青色域から黄色域まで幅広く分布するため、例えば並置した複数の発光装置を点灯する構造の表示装置で従来の半導体発光装置を用いると、色調バラつきが大きく、表示品位が低下する問題が生じる。

【００１０】従来の半導体発光装置に伴う第三の問題は、側面から正面に至る各指向角方向に対する放射光に大きな色調ムラを生ずる点にある。カップ部(3)に注入したコーティング(11)を加熱硬化する際、コーティング(11)を構成する樹脂の粘度が比較的長時間にわたり大きく低下するため、比重の大きいYAG：Ce系蛍光体(9)はコーティング(11)中で沈降し、カップ部(3)の底部と半導体発光素子(4)上に堆積する。

【００１１】図１１は、YAG：Ce系蛍光体(9)の沈降状態を示す従来の半導体発光装置の部分断面図である。沈降したYAG：Ce系蛍光体(9)の濃度の高いカップ部(3)の底部と青色系半導体発光素子(4)上面からの放射光は黄色味を帯びるが、YAG：Ce系蛍光体(9)の濃度が低い青色系半導体発光素子(4)側面からの放射光は青味を帯びる。このため、従来の半導体発光装置の放射光を壁面等に投射すると、放射光の中心から外側に向かって黄色、青色、黄色の順で並んだリング状の色調ムラを観察できる。従って、例えば放射光を拡大して表示するバックライト等の用途に従来の半導体発光装置を用いると、色調ムラが大きく低品位表示となる。

【００１２】従来の半導体発光装置に派生する第四の問

題は、第二の問題である色調バラつきや第三の問題である色調ムラが必然的に増幅される点にある。YAG：Ce系蛍光体(9)の発光成分と青色系半導体発光素子(4)の透過光成分とが混色された光が外部に放出される際に、例えばYAG：Ce系蛍光体(9)の濃度又は注入量が多いと、青色系半導体発光素子(4)から放射された光がYAG：Ce系蛍光体(9)に入射する割合は大きくなり、YAG：Ce系蛍光体(9)の発光は増大するが、同時にコーティング(11)を透過する青色系半導体発光素子(4)の放射光はその分だけ減少する。逆に、YAG：Ce系蛍光体(9)の濃度又は注入量が少ないと、コーティング(11)を透過する青色系半導体発光素子(4)の放射光は増加する。このように、YAG：Ce系蛍光体(9)の発光成分と青色半導体発光素子(4)の透過光成分は、一方が増えれば他方が相対的に減る関係にある。従って、従来の半導体発光装置では、コーティング(11)の注入量及びコーティング(11)中の蛍光体(9)の濃度が僅かでも変わると混色によって生成される放射光の色調は大きく変動する。このように、半導体発光素子(4)の発光成分は、YAG：Ce系蛍光体(9)の励起光であると同時に、混色光の成分になる動作原理のため、従来の半導体発光装置では、その利点を十分に生かすことができない。

【００１３】要するに、従来の半導体発光装置は、下記の問題を解決しなければならない。

【１】シャープな発光スペクトルが要求される表示装置の光源に使用する場合に色純度が悪く鮮やかな色彩を表現できない。

【２】コーティング(11)の注入量及びコーティング(11)中の蛍光体(9)の不均一な濃度により、表示装置全体の発光色調に大きなバラつきが生ずる。

【３】側面から正面に至る各指向角方向への発光色の色調ムラが大きい。

【４】動作原理上の問題から色調バラつきが増幅されやすい。

【００１４】そこで、本発明は、発光スペクトルがシャープで鮮やかな色彩表現が可能であり、色度バラつきが少ない半導体発光装置を提供することを目的とする。また、本発明は、長寿命で作動でき且つ水銀を使用せず環境に優しい半導体発光装置を提供することを目的とする。更に、本発明は、機械的衝撃に強く、発熱が少なく、高電圧が不要で、高周波ノイズを発生しない半導体発光装置を提供することを目的とする。

【００１５】

【課題を解決するための手段】本発明による半導体発光装置は、一対の配線導体(1，2)と、一対の配線導体(1，2)の一方の端部に形成されたカップ部(3)と、カップ部(3)内に接着され且つ配線導体(1，2)に電気的に接続されて近紫外光を発生する半導体発光素子(4)と、半導体発光素子(4)の周囲に設けられた蛍光層(10)と、半導体発光素子(4)、ボンディングワイヤ(6，7)、配線導体の一方の端部及び蛍光層(10)とを被覆する透明な封止体(8)とを備えている。蛍光層(10)は、半導体発光素子(4)から照射される近紫外光によって励起され半導体発光素子(4)の発光と異なる波長の光を発する一種以上の蛍光体(9)を含む。また、蛍光層(10)は、メタロキサン結合を主体とする液状のセラミックコーティング剤を固化させた透明なポリメタロキサンゲルより成る。半導体発光素子(4)から発生する近紫外光の発光スペクトルは、非常に鋭利なピークを持ち尖鋭度が高いので、半導体発光素子(4)の近紫外光を蛍光層(10)で波長変換することにより、従来の半導体発光装置に比べ、発光スペクトルがシャープで鮮やかな色彩表現が可能であり、色度バラつきが少ない。また、半導体発光素子(4)の近紫外光により励起される複数類の蛍光体(9)を蛍光層(10)に混入できるので、発光スペクトル等所望の特性に合致する蛍光体(9)を選択できる。蛍光体(9)を封入する蛍光層(10)に紫外線耐性の高いポリメタロキサンゲルを用いるため、蛍光層(10)に劣化が発生せず、衝撃等の機械的強度が向上する。また、青色、緑色、赤色のシャープなスペクトルを持つ蛍光体(9)を組み合わせると、色純度の優れた鮮やかな色彩を表現できる白色光源を実現できる。近紫外光により蛍光体(9)を励起するため観察者に殆ど視認されず、蛍光体(9)の発光成分だけで放射光の色調が決定されるので、蛍光体(9)の注入量や濃度が不均一でも色調のバラつきは起こらない。

【００１６】本発明の実施の形態では、半導体発光素子(4)は、窒化ガリウム系化合物半導体層を有する発光ピーク波長３６５nm～４００nmの近紫外線を発生する。半導体発光素子(4)の周囲は、カップ部(3)の内面に設けられた蛍光層(10)により被覆されるので、半導体発光素子(4)から発生する全ての光は蛍光層(10)を通過した後、封止体(8)を通り外部に放出される。

【００１７】半導体発光素子(4)から発生する光と蛍光層(10)により波長変換された光とを混合する光散乱層(13)がカップ部(3)内に設けられるので、光散乱層(13)により十分な光の混合が行われる。光散乱層(13)は、セラミック粉末を混合した透明樹脂又はセラミック粉末を混合したセラミックコーティング剤を固化して形成される。セラミックコーティング剤は、単一の金属元素より成る単一金属アルコキシド、複数の金属元素より成る複合金属アルコキシド又は単一金属アルコキシド若しくは複合金属アルコキシドの官能基の一部を修飾して有機樹脂モノマーを導入した無機・有機複合体を加水分解縮重合して得られる金属酸化物ポリマを主体とした液状のゾル又はポリシラザンを主体とする液状のゾルである。

【００１８】セラミックコーティング剤は、金属塩化物ガス及び水素、酸素の混合気体を高温で燃焼させる火炎加水分解法によって生成された約５nm～５０nmの直径を有する単一の金属元素より成る単一超微粒子状金属酸化物又は複数の金属元素より成る複合超微粒子状金属酸化

物を主体とする液状のゾルである。

【００１９】半導体発光素子(4)をカップ部(3)に接着する接着剤(5)は、微小な金属薄片を混合した一液性エポキシ樹脂より成る熱硬化性導電ペースト、一液性エポキシ樹脂より成る熱硬化性有機樹脂に光透過性セラミック粉末を混合した光透過性ペースト、金属アルコキシド又は超微粒子状金属酸化物を出発原料とした光透過性無機系接着剤である。封止体(8)は、光透過性を有する有機樹脂又は金属アルコキシドの官能基の一部を修飾して有機樹脂モノマーを導入した無機若しくは有機複合体ポリマより成る。封止体(8)は、紫外線吸収剤を含有してもよい。

【００２０】

【発明の実施の形態】以下、本発明による半導体発光装置の実施の形態を図１～図４について説明する。図１は、本発明による半導体発光装置による第一の実施の形態の部分断面図を示す。本実施例の半導体発光装置は、一対の配線導体(1，2)と、一対の配線導体(1，2)の一方の端部に形成されたカップ部(3)と、カップ部(3)内に接着剤(5)によって接着された半導体発光素子(4)と、半導体発光素子(4)の第一の電極及び第二の電極と一対の配線導体(1，2)の一方の端部とを接続するボンディングワイヤ(6，7)と、半導体発光素子(4)の周囲に設けられた蛍光層(10)と、半導体発光素子(4)、ボンディングワイヤ(6，7)、配線導体(1，2)の一方の端部及び蛍光層(10)とを被覆する透明な封止体(8)とを備えている。蛍光層(10)は、半導体発光素子(4)から照射される近紫外光によって励起され且つ半導体発光素子(4)の発光波長と異なる波長の光を発する一種以上の蛍光体(9)を含み、かつメタロキサン結合を主体とする液状のセラミックコーティング剤を固化させた透明なポリメタロキサンゲルより成る。

【００２１】半導体発光素子(4)は、発光ピーク波長３９０nmの近紫外光を発生するInGaN系半導体発光素子により構成される。半導体発光素子(4)は、SiCなどの半導体基板又はサファイヤなどのセラミック基板上に、エピタキシャル成長などの単結晶成長法によって形成されたInGaN、GaNなどの窒化ガリウム系化合物半導体層を有する発光ピーク波長が３６５nm～４００nmの近紫外半導体発光素子である。

【００２２】蛍光層(10)は、金属アルコキシドを出発原料とするセラミックコーティング剤に所定の比率で青色、緑色、赤色の三種の蛍光材料を混合して混合物を形成し、半導体発光素子(4)が固定されたカップ部(3)内に混合物を塗布し硬化させることにより形成される。蛍光体(9)を構成する三種の蛍光材料は、白色光を発生する所定の比率で混合される。

【００２３】蛍光層(10)は、半導体発光素子(4)から照射される近紫外光によって励起され半導体発光素子(4)の発光と異なる波長の光を発する一種以上の蛍光体(9)を含み、かつメタロキサン結合（M-O-M結合、M：金属）を主体とする液状のセラミックコーティング剤を固化させたポリメタロキサンゲルより成る。ポリメタロキサンゲルは半導体発光素子(4)から照射される近紫外光に対して光透過性を有し、かつ、耐熱性及び紫外線耐性を有する。従って、本発明の半導体発光装置の蛍光層(10)の構成要素としては最適である。

【００２４】セラミックコーティング剤は、金属アルコキシド、ポリシラザン、超微粒子状金属酸化物などの出発原料を、それぞれ下記に示す方法によって金属酸化物ポリマを主体とする液状のゾルに加工したものである。

【００２５】金属アルコキシドは、化学式M(OR)n，M：金属、R：アルキル基、で表される有機金属化合物であり、例えばシリコン、アルミニウム、チタン、ジルコニウムなどの単一の金属元素より成る単一金属アルコキシド、又は複数の金属元素より成る複合金属アルコキシドである。また、金属アルコキシドの官能基の一部を修飾して有機樹脂モノマーを導入した無機・有機複合体を用いることも可能である。

【００２６】金属アルコキシドをアルコールなどの溶媒に分散し水と微量の触媒とを滴下して混合すると下記の化学式で示す加水分解縮合反応を生じる。

M(OR)n+xH2O→M(OH)x(OR)n-x + xROH

(-M-OH) + (H-O-M) → (-M-O-M) +H2O

(-M-OH) + (R-O-M) → (-M-O-M) +ROH

【００２７】上記の反応により、溶媒中には金属酸化物のポリマが生じるが、途中で反応を停止させると金属酸化物のポリマが溶媒に分散した状態となった液状のゾルが得られ、セラミックコーティング剤として用いることができる。

【００２８】ポリシラザンは、化学式-SiH2-NH-を基本構造とした無機化合物であり、ジクロロシランとピリジンの錯体にアンモニアを導入して合成される。ポリシラザンをキシレンなど適当な溶媒で希釈した液状のゾルをセラミックコーティング剤として用いることができる。

【００２９】超微粒子状金属酸化物は、例えばシリコン、アルミニウム、チタン、ジルコニウムなどの単一の金属元素より成る単一超微粒子状金属酸化物、又は複数の金属元素より成る複合超微粒子状金属酸化物であり、金属塩化物ガス及び水素、酸素の混合気体を高温で燃焼させる火炎加水分解法によって生成された直径が約５nm～５０nmの金属酸化物微粉体である。超微粒子状金属酸化物をアルコールなどの溶媒に分散させ水を滴下して混合すると液状のゾルが得られ、セラミックコーティング剤として用いることができる。

【００３０】本発明による第一の半導体発光装置の蛍光層(10)は、セラミックコーティング剤に粉末状の蛍光体(9)を混合し、予め接着剤(5)によって半導体発光素子(4)が接着されたカップ部(3)にディスペンス、プリディップなどの方法によって注入し、空気中に放置して溶媒

を揮発させた後、加熱硬化させて形成される。また、本発明による第二の半導体発光装置の蛍光層(10)は、セラミックコーティング剤に粉末状の蛍光体(9)を混合し、ディスペンス、プリディップなどの方法によってカップ部(3)の内面に薄く塗布し、空気中に放置して溶媒を揮発させた後、加熱硬化させて形成される。

【００３１】封止体(8)は、光透過性を有するエポキシ樹脂、シリコーン樹脂、ポリエステル樹脂、アクリル樹脂などの有機樹脂、又は金属アルコキシドの官能基の一部を修飾して有機樹脂モノマーを導入した無機・有機複合体ポリマより成り、ポッティング、射出成形などの方法によって形成される。半導体発光素子(4)の近紫外光によって封止体(8)の劣化を防ぐため、封止体(8)に紫外線吸収剤を添加してもよい。

【００３２】光散乱層(13)は、封止体(8)と同一の有機樹脂又は蛍光層(10)に用いられるセラミックコーティング剤と同一のセラミックコーティング剤に、シリカ、アルミナ、酸化チタンなどのセラミック粉末を適量混合し、カップ部(3)にディスペンス、プリディップなどの方法によって注入した後、所定の硬化条件で固化して形成される。なお、光散乱層(13)は半導体発光素子(4)からの近紫外光を受けるので、光散乱層(13)の劣化を防ぐには構成材料としてセラミックコーティング剤を選択することが望ましい。

【００３３】ボンディングワイヤ(6，7)は、金、銀、アルミニウム、銅などからなる金属細線である。接着剤(5)は金、銀などの微少な金属薄片を混合した一液性エポキシ樹脂より成る熱硬化性導電ペースト、又は、一液性エポキシ樹脂より成る熱硬化性有機樹脂に光透過性セラミック粉末を混合した光透過性ペースト、又は金属アルコキシドまたは超微粒子状金属酸化物を出発原料とした光透過性無機系接着剤である。

【００３４】半導体素子(4)及び蛍光層(10)が形成されたカップ部(3)を含む一対の配線導体(1，2)の端部をポット内に収容し、一対の配線導体(1，2)の周囲に透明なビスフェノール系エポキシ樹脂を充填し硬化させるポッティング法によって、封止体(8)が形成される。封止体(8)には紫外線吸収剤が添加されないが、必要に応じて添加してもよい。表１は蛍光体(9)の諸特性を示す。

【００３５】

【表１】

発光色	組成	発光ピーク波長	比重
青色	$Sr_5(PO_4)_3Cl:Eu$	445nm	4.15
緑色	$3(Ba,Mg)O\cdot 8Al_2O_3:Eu,Mg$	514nm	3.8
赤色	$Y_2O_2S:Eu$	624nm	5.1

【００３６】従来の半導体発光装置では、図７に示すように非常に幅の広い発光スペクトルが発生したのに対し、本発明による実施の形態の半導体発光装置の発光スペクトルは、図３に示すように、非常に鋭利なピークを持ち尖鋭度が高いのが特徴である。図８に示す三波長冷陰極蛍光管の発光スペクトルに近似するため、本発明による半導体発光装置は三波長冷陰極蛍光管に代わる白色光源として透過型カラー液晶表示装置に使用することもできる。図３に示すように、異なる５つの波長領域にピークが発生するが、一番短波長側のピークは半導体発光素子(4)からの透過光成分を示し、その他の４つのピークは表１に示す各蛍光体(9)の発光である。また７００nmの波長付近に赤色蛍光体(9)Y2O2S：Euの小さなピークが見られる。図３に示すように、半導体発光素子(4)からの透過光成分が強く照射されるが、蛍光層(10)の各材質及び各量を最適化し又は紫外線吸収剤を封止体(8)に添加することにより、半導体発光素子(4)からの近紫外光を十分吸収すれば、実用上問題のない水準まで近紫外光量を減少させることができる。従来の半導体発光装置の図１０に示す色度分布と比べると、本発明による半導体発光装置の色度分布は、図４に示すように、バラつきの幅が非常に狭く、優れた特性を持つ。

【００３７】従来の半導体発光装置に用いられるYAG：Ce系蛍光体の比重４．８～４．９に対して、本実施の形態に用いる青色及び緑色蛍光体(9)の比重は小さいが、赤色蛍光体(9)の比重は若干大きいため、赤色蛍光体(9)の沈降量はYAG：Ce系蛍光体の沈降量に比べて大きい。青色系半導体発光素子(4)の発光を蛍光体の励起光成分と半導体発光装置自体の発光成分とに兼用する従来の半導体発光装置に対し、本発明の半導体発光装置では、蛍光体(9)を励起する近紫外光は観測者に殆ど視認されないため、赤色蛍光体(9)の比重がYAG：Ce系蛍光体の比重より大きいにも拘わらず、蛍光体(9)の発光成分だけで本発明による半導体発光装置の放射光の色調が決定される。従って、従来に比べて、本発明による実施の形態の方が色度バラつきが遙かに小さくなると考えられる。

【００３８】一般に半導体発光素子(4)は、構成する半導体の持つエネルギギャップに応じた波長の光を発するため、半導体発光素子の組成を変えない限り発光波長を変えることができないが、本発明による半導体発光装置は、同一の半導体発光素子(4)を用いながら、使用する蛍光体(9)の種類と配合を変えて様々な色調を作成することができ、応用範囲が広く商品価値の高い半導体発光装置である。

【００３９】また、図２に本発明による半導体発光装置の第２の実施の形態を示す。第二の実施の形態による半導体発光装置は、カップ部(3)の内面を被覆する蛍光層(10)と、半導体発光素子(4)と蛍光層(10)とを被覆する光散乱層(13)と、半導体発光素子(4)、ボンディングワイヤ(6，7)、配線導体の一方の端部、蛍光層(10)及び光

散乱層(13)とを被覆する透明な封止体(8)より成り、他の構成は図１と同じである。

【００４０】なお、特に図示しないが、本発明による半導体発光装置のその他の形態として、一対の配線導体(1，2)と、一対の配線導体(1，2)の一方の端部の双方に渡って設けられたカップ部(3)と、同一平面上に設けられた第一の電極と第二の電極とが金属バンプ又は導電性接着剤を介してカップ部(3)に接着された半導体発光素子(4)と、カップ部(3)の内面又は半導体発光素子(4)の周囲を被覆する蛍光層(10)と、半導体発光素子(4)、金属バンプ又は導電性接着剤、一対の配線導体(1，2)の一方の端部及び蛍光層(10)とを被覆する透明な封止体(8)とで構成することもできる。本発明による半導体発光装置は、いわゆるフリップチップ構造で構成することもできる。

【００４１】従来の半導体発光装置に比べ、本発明による半導体発光装置は、下記の優れた特徴を持つ。まず、本発明による半導体発光装置の第一の特徴は、３６５nm～４００nmの波長領域に発光ピーク波長が存在する半導体発光素子(4)の近紫外光により励起される多種類の蛍光体(9)を蛍光層(10)に混入するので、発光スペクトル等を所望の特性に合致する蛍光体(9)を選択できる点にある。一般に可視光で励起できる蛍光体は極めて少なく、近紫外域より短波長で励起できる蛍光体が殆どである。従来の半導体発光装置の励起光源に用いられる青色系の半導体発光素子のピーク波長範囲である４００nm～５３０nmで励起でき且つ劣化の少ない実用的な蛍光体は、実際上、YAG：Ce系蛍光体以外に殆どない。

【００４２】本発明による半導体発光装置の第二の特徴は、蛍光体(9)を封入する蛍光層(10)に紫外線耐性の高いポリメタロキサンゲルを用いる点である。従来の半導体発光装置では、YAG：Ce系蛍光体を含有するコーティングとして使用される樹脂は紫外線を受けると劣化するため、近紫外光を発生する半導体発光素子(4)を使用できない。

【００４３】本発明による半導体発光装置の第三の特徴は、色純度の優れた鮮やかな色彩を表現できる白色光源を実現できる点である。発光スペクトルの幅が非常に広いYAG：Ce系蛍光体を使用するため、色純度が悪く鮮やかな色彩を表現できない従来の半導体発光装置は、透過型カラー液晶表示装置の用途に適さない。

【００４４】一方、本発明による半導体発光装置は、青色、緑色、赤色のシャープなスペクトルを持つ蛍光体(9)を組み合わせると、冷陰極蛍光管と同様なスペクトル分布が得られ、色純度の優れた鮮やかな色彩を表現できる白色光源を実現できる。

【００４５】本発明による半導体発光装置の第四の特徴は、原理的に色調バラつき及び色調ムラが少ない点である。従来の半導体発光装置は、青色系半導体発光素子の発光をYAG：Ce系蛍光体の励起光と、従来の半導体発光装置自体の放射光の一成分とに兼用する動作原理を持つ。このためコーティングの注入量及びコーティング中のYAG：Ce系蛍光体の濃度がわずかでもバラつくと、従来の半導体発光装置の放射光の色調は大きくバラつく。また、従来の半導体発光装置は、カップ部(3)内で比重の大きいYAG：Ce系蛍光体が沈降すると、側面から正面に至る各指向角方向における放射光の色調ムラが大きい。

【００４６】本発明による半導体発光装置では、近紫外光により蛍光体(9)を励起するため観察者に殆ど視認されず、蛍光体(9)の発光成分だけで放射光の色調が決定されるので、蛍光体(9)の注入量や濃度が不均一でも色調のバラつきは起こらない。また同様に、カップ部(3)内で蛍光体(9)の沈降が発生しても各指向角方向への放射光の色調ムラは発生しない。この様に、本発明による半導体発光装置は、従来の半導体発光装置の持つ多くの問題点を根本的に解決し、より優れた半導体発光装置を実現することができる。

【００４７】図５は、絶縁性基板を使用するチップ形発光ダイオード装置に適用した本発明による第三の実施の形態を示す。チップ形発光ダイオード装置は、一方の主面にカップ部(3)が形成された基体となる絶縁性基板(14)と、絶縁性基板(14)に相互に離間して形成された第一の配線導体(1)及び第二の配線導体(2)と、第一の配線導体(1)のカップ部(3)に接着剤(5)を介して固着された半導体発光素子(4)と、半導体発光素子(4)のアノード電極(4a)と第１の配線導体(1)とを電気的に接続する第一のボンディングワイヤ(6)と、半導体発光素子(4)のカソード電極(4b)と第２の配線導体(2)とを電気的に接続する第二のボンディングワイヤ(7)と、カップ部(3)内に充填され半導体発光素子(4)、アノード電極(4a)、カソード電極(4b)及びアノード電極(4a)、カソード電極(4b)に接続されたボンディングワイヤ(6，7)の端部を被覆する蛍光層(10)と、絶縁性基板(14)の一方の主面に形成され且つ蛍光層(10)の外側を被覆する台形状断面の封止体(8)とを備えている。第１の配線導体(1)及び第２の配線導体(2)の一方の端部は、カップ部(3)内に配置される。半導体発光素子(4)はカップ部(3)の底部(3a)にて第１の配線導体(1)に接着剤(5)を介して固着される。第１の配線導体(1)及び第２の配線導体(2)の各他方の端部は、絶縁性基板(14)の側面及び他方の主面に延びて配置される。蛍光層(10)はカップ部(3)の上端部(3b)から突出しない。半導体発光素子(4)から照射される光は、蛍光層(10)内を通過した後、蛍光層(10)を被覆する封止体(8)の外部に放出される。

【００４８】半導体発光素子(4)から放射された光は蛍光層(10)に達し、その一部は蛍光層(10)内で異なる波長に波長変換され、波長変換されない半導体発光素子(4)からの光成分と混合されて封止体(8)を通して外部に放出される。特定の発光波長を吸収する光吸収物質、半導

体発光素子(4)の発光を散乱する光散乱物質(10b)又は蛍光層(10)のクラックを防止する結合材を蛍光層(10)内に配合してもよい。

【００４９】前記のいずれの点でも、本発明による半導体発光装置の優位性は明らかである。前記実施の形態は例示に過ぎず、本発明はこれらに限定されない。例えば、表１に示す青色、緑色、赤色の各蛍光体(9)を単独で用いれば、それぞれ青色、緑色、赤色の光を発する半導体発光装置が得られる。また、二種以上の蛍光体(9)を適当な配合比で組み合わせれば、その配合比に応じた中間色の光を発する半導体発光装置が得られる。

【００５０】

【発明の効果】前記のように、本発明による半導体発光装置は、従来の半導体発光装置に比べ、発光スペクトルがシャープで鮮やかな色彩表現が可能であり、色度バラつきが少なく複数個を並べて点灯できるなど優れた特徴を持つため、管球式光源に代わる本格的な次世代固体化光源として大いに期待される。

【図面の簡単な説明】

【図１】　本発明による第一の半導体発光装置を示す断面図

【図２】　本発明による第二の実施の形態を示す断面図

【図３】　本発明による半導体発光装置の発光スペクトルを示すグラフ

【図４】　本発明による半導体発光装置の色度分布を示すグラフ

【図５】　チップ型半導体発光素子に適用した本発明の第三の実施の形態を示す断面図

【図６】　従来の半導体発光装置を示す断面図

【図７】　従来の半導体発光装置から得られる発光スペクトルを示すグラフ

【図８】　三波長冷陰極蛍光管の発光スペクトルを示すグラフ

【図９】　透過型カラー液晶表示装置のカラーフィルタの透過スペクトルの一例

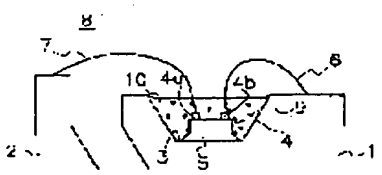
【図１０】　従来の半導体発光装置の色度分布の一例

【図１１】　従来の半導体発光装置のYAG：Ce系蛍光体の沈降状態の模式図

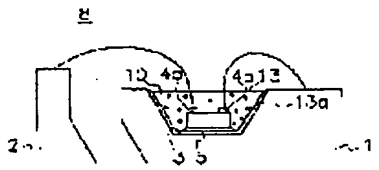
【符号の説明】

(1, 2)・・配線導体、　(3)・・カップ部、　(4)・・半導体発光素子、　(5)・・接着剤、　(6, 7)・・ボンディングワイヤ、　(8)・・封止体、　(9)・・蛍光体、(10)・・蛍光層、　(11)・・コーティング、　(12)・・モールド部材、(13)・・光拡散層、

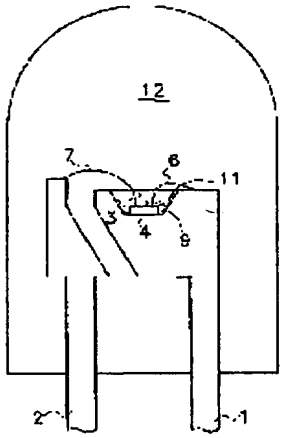
【図１】



【図２】



【図６】



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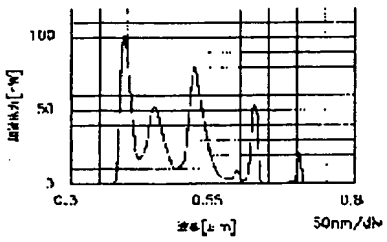
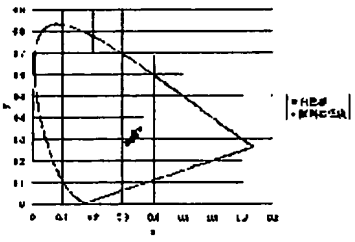


【図４】



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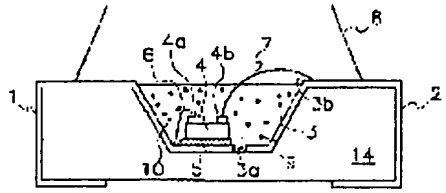

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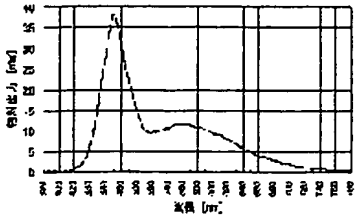
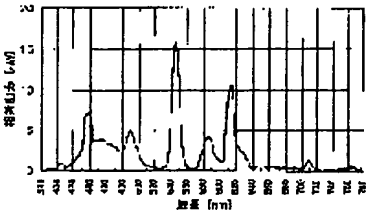


【図８】



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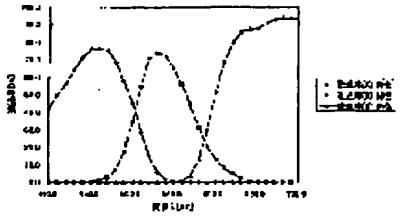
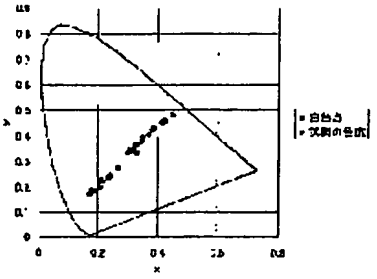


【図１０】



【図１１】